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FLOOD INSURANCE STUDY

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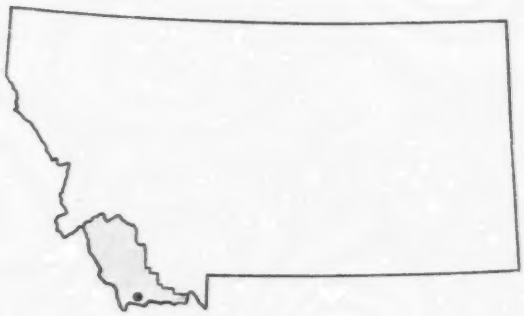
TOWN OF LIMA, MONTANA
BEAVERHEAD COUNTY



MARCH 4, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 300177

JBH

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Junction Creek Panel 01P-03P

Exhibit 2 - Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map

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1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Lima, Beaverhead County, Montana, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the Town of Lima to the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

This Flood Insurance Study was prepared by compiling existing hydrologic and hydraulic technical and scientific data prepared by other organization(s) originally for purposes other than the National Flood Insurance Program (NFIP). The data were identified as the best available at the time of compilation of this Flood Insurance Study and should depict the general conditions of the flooding sources with relative accuracy. FEMA performed a cursory review and accepted the data as valid for purposes of this Flood Insurance Study and the NFIP. However, if better information is known to exist or has been developed since the date of this report, the information should be immediately forwarded to the address below for consideration for revision of this study.

> Natural and Technological Hazards Division, FEMA, Building 710, Denver Federal Center, Lakewood, Colorado 80225

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which this federally supported study is based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3(c). In such cases, however, it shall be understood that the State (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Morrison-Maierle, Inc., as reported in the Flood Insurance Study

for the City of Dillon, the Town of Lima, and the unincorporated areas of Beaverhead County, Montana (Reference 1). This analysis was subsequently revised using information provided by the State of Montana.

1.3 Coordination

A Flood Insurance Study was prepared that included the incorporated areas of the City of Dillon and the Town of Lima, and the unincorporated areas of Beaverhead County, Montana (Reference 1). In preparing this study, the streams requiring detailed study were identified at a meeting, held on June 23, 1977, attended by representatives of Beaverhead County, the City of Dillon, the Floodplain Management Section of the Montana Department of Natural Resources and Conservation, FEMA, and the study contractor.

Local coordination was maintained throughout the study with the Beaverhead Planning Department and the flood plain administrator. Other agencies involved in reviewing the hydrologic analysis were the U.S. Geological Survey, Helena office; the U.S. Soil Conservation Service, Bozeman office; and the U.S. Bureau of Reclamation, Billings office.

The final coordination meeting was held on July 30, 1981, for the City of Dillon and the Town of Lima. Representatives of FEMA, the study contractor, Beaverhead County, and the City of Dillon attended the meeting. No problems were raised at the meeting for the City of Dillon or the unincorporated areas of Beaverhead County. Representatives of the Town of Lima, however, requested that their study be revised based on new information that the town had submitted to the State of Montana.

On November 8, 1984, Dames & Moore was instructed by FEMA to produce an existing data study for the Town of Lima, Montana, using the new information supplied by the State of Montana and the detailed study data for Junction Creek from the previously published City of Dillon - Town of Lima - unincorporated areas of Beaverhead County, Montana, Flood Insurance Study (Reference 1).

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the Town of Lima, Beaverhead County, Montana. The area of study is shown on the Vicinity Map (Figure 1).

Junction Creek and Junction Creek Overflow were studied by detailed methods for their entire lengths affecting the Town of Lima. Alder Creek was studied by approximate methods from its confluence with Junction Creek to the Lima corporate limits.

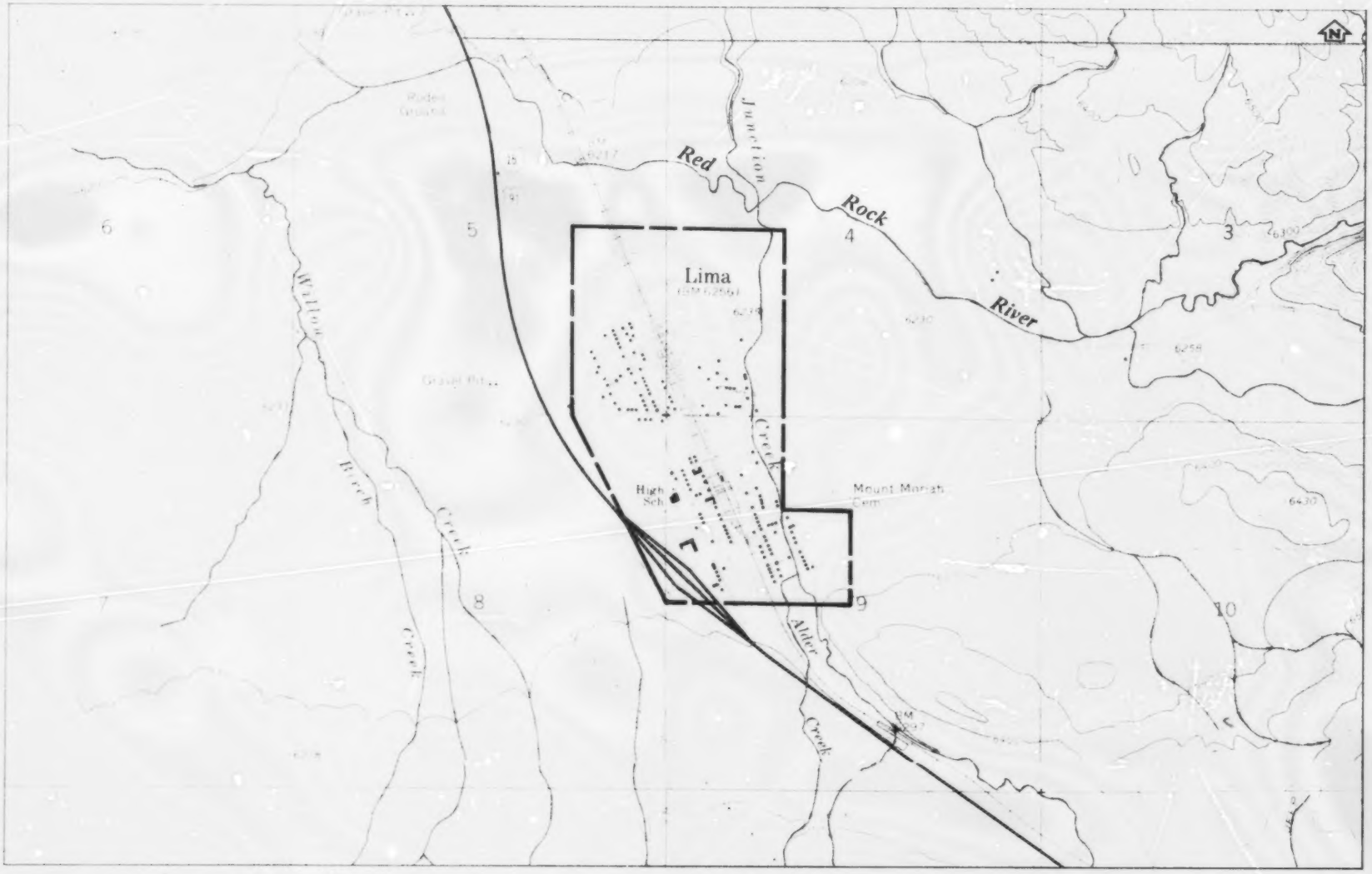

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF LIMA, MT
(BEAVERHEAD CO.)

APPROXIMATE SCALE

2000 0 2000 4000 6000 FEET

VICINITY MAP

The areas studied by detailed methods were selected based on the extent and validity of available hydrologic and hydraulic data.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards.

2.2 Community Description

The Town of Lima lies in south-central Beaverhead County, which is located in the southwest corner of Montana. Lima is surrounded by the unincorporated areas of Beaverhead County. The estimated population of Lima was 272 in 1980 (Reference 2). Future growth is expected to be minimal.

Development in the flood plains has increased with the trend to build along attractive stream frontage. New development, however, is sparse because the majority of the flood plain is in the established portion of the community, with little potential for new residential or commercial development.

Lima lies in the Beaverhead River Basin, which is in the center of Beaverhead County. This river basin is a typical high mountainous area originating along the Continential Divide. Mountain peaks in the basin are typically rugged and barren, whereas intervening valleys and lower slopes support good stands of vegetation. The lower valleys are relatively wide and are suited to various agricultural endeavers (Reference 3). Elevations in Lima range from approximately 6,220 feet National Geodetic Vertical Datum (NGVD) in the northern portion of the town to approximately 6,300 feet NGVD in the south.

Junction Creek originates in the hills to the south of Lima and flows north through town until its confluence with the Red Rock River north of Lima. The drainage area of Junction Creek at Lima is approximately 138 square miles.

Peak precipitation occurs in May and June, with a mean annual precipitation of 10.85 inches in Lima (Reference 3). Mean temperatures in the area range from 60°F in July to 17°F in January. Cloudy skies and frequent periods of showers typically occur in the spring. Summer and early fall are characterized by long periods of clear, sunny weather. The growing season is short, varying from 90 to 120 days.

The soils in Beaverhead County are closely related to the physiographic subdivisions of the county. The physiography is, in turn, closely related to the geology of the underlying parent materials. Lima is located in one of several broad intermontane valleys separating the mountain ranges in Beaverhead County. Soils in these valleys have developed on two physiographic levels. In the upland terraces and benches of the valleys, they are deep to moderately

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deep and develop in tertiary sediments and older alluvial fans. The deep to moderately deep soils are used for irrigated crops, dryland farming, and grass pasture. The inner valley river terrace soils are very shallow to moderately deep, depending on their relationship to the physiographic flood plain level. The inner valley soils are developed in alluvial sand, gravel, silt, and clay and are used predominantly for irrigated cropping and sub-irrigated grass hay.

2.3 Principal Flood Problems

A special flooding problem occurs where the flow in Junction Creek separates approximately 1.2 miles upstream from Lima. The limited capacity of the Union Pacific Railroad bridge at this site causes water to overtop the left bank and flow into Lima along a separate path on the west side of the railroad. This overflow, referred to as Junction Creek Overflow, causes shallow flooding with an average depth of less than 1 foot between the railroad and Harrison Street. At the railroad bridge, approximately 35 percent (245 cubic feet per second (cfs)) of the 100-year floodflow leaves the Junction Creek main channel. Three culverts located approximately 0.3 mile upstream from the Lima corporate limits allow a flow of 152 cfs to move under the tracks and back into the main channel of Junction Creek via Alder Creek. The remaining 100-year overflow of 93 cfs inundates the area between the railroad and Harrison Street. Some of this flow overtops the railroad at Peak Street and flows east along the street and back into Junction Creek. Shallow flooding, with an average depth of less than 1 foot, also occurs along the left overbank of the main channel of Junction Creek between Alder Creek and Third Avenue.

2.4 Flood Protection Measures

There are no flood control structures within the Town of Lima.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk

of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

To define the discharge-frequency relationship for Junction Creek (an ungaged stream) at Lima, a regional relationship relating drainage area to discharges was developed for nearby gaging stations and used to determine the 10-, 50-, 100-, and 500-year floods. A straight line extension of a log plot of the flows was used to determine the flows beyond the method limits.

Approximatley 1.2 miles upstream of Lima, Junction Creek is directed through a small arched bridge under the Union Pacific Railroad. Capacity is limited, and excess flow overtops the left overbank and travels between the railroad and Harrison Street. The control section at the upstream entrance of the railroad structure was field surveyed and used in the hydraulic analysis to determine the flow distribution between Junction Creek and Junction Creek Overflow. Some of the overflow is diverted back into Junction Creek through culverts under the railroad located on Alder Creek. The remaining overflow reaches Lima and continues as shallow flooding adjacent to the railroad. Some of the flow overtops the railroad at Peak Street, resulting in further transfer of floodwater back into Junction Creek.

Peak discharge-drainage area relationships for Junction Creek and Junction Creek Overflow are shown in Table 1.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Water-surface elevations of floods of the selected recurrence intervals were computed using the U.S. Army Corps of Engineers' HEC-2 step-backwater computer program (Reference 4). Cross section data were obtained by field survey.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments

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Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Junction Creek					
Above Union Pacific Railroad 1 Mile Southeast of Lima	138	420	620	700	910
Below Union Pacific Railroad	138	367	427	455	500
Below Alder Creek	138	420	564	607	672
Junction Creek Overflow					
Below Union Pacific Railroad	138[1]	53	193	245	410
Below Alder Creek	138[1]	1	56	93	238

[1]Part of Junction Creek Drainage Area

for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness factors (Manning's "n" values) for channel and overbank areas were estimated using the U.S. Geological Survey Water-Supply Paper 1849 (Reference 5), various texts, and engineering judgment based on aerial photographs (Reference 6) and field inspection. Manning's "n" values for Junction Creek range from 0.040 to 0.050 within the channel and from 0.040 to 0.070 in overbank areas.

Starting water-surface elevations for Junction Creek were obtained by using the slope-area method.

The 100-year flood plain for Alder Creek was determined by engineering judgment using aerial photographs (Reference 6).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Water-surface elevations used for areas subject to shallow flooding were determined from backwater analyses (Reference 4) and related to ground-surface elevations to determine the depth of flooding.

All elevations are referenced to the NGVD. Elevation reference marks used in this study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by the FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were developed photogrammetrically using aerial photographs at a scale of 1:9,600 (Reference 6).

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The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year flood plain boundary is shown.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. In Montana, the standards are more restrictive. The Montana Administration Code 36-2, 14B(2) 51420, Floodway Delineation Section 89-3501 of Revised Code of Montana, 1947, provides that the increase in flood height be restricted to 0.5 foot. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 0.5 foot at any point. Typical relationships

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Junction Creek								
A	0	68	114	5.3	6,221.2	6,221.2	6,221.6	0.4
B	1,327	25	61	10.0	6,234.1	6,234.1	6,234.1	0.0
C	2,457	24	93	6.5	6,242.0	6,242.0	6,242.0	0.0
D	2,830	44	80	7.5	6,244.5	6,244.5	6,244.5	0.0
E	3,632	27	67	9.0	6,250.8	6,250.8	6,250.8	0.0
F	4,417	28	116	5.2	6,259.1	6,259.1	6,259.1	0.0
G	4,778	42	167	3.6	6,264.3	6,264.3	6,264.5	0.2
H	5,465	30	70	8.7	6,272.2	6,272.2	6,272.2	0.0

[1] Feet Above Corporate Limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF LIMA, MT
(BEAVERHEAD CO.)

FLOODWAY DATA

JUNCTION CREEK

between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

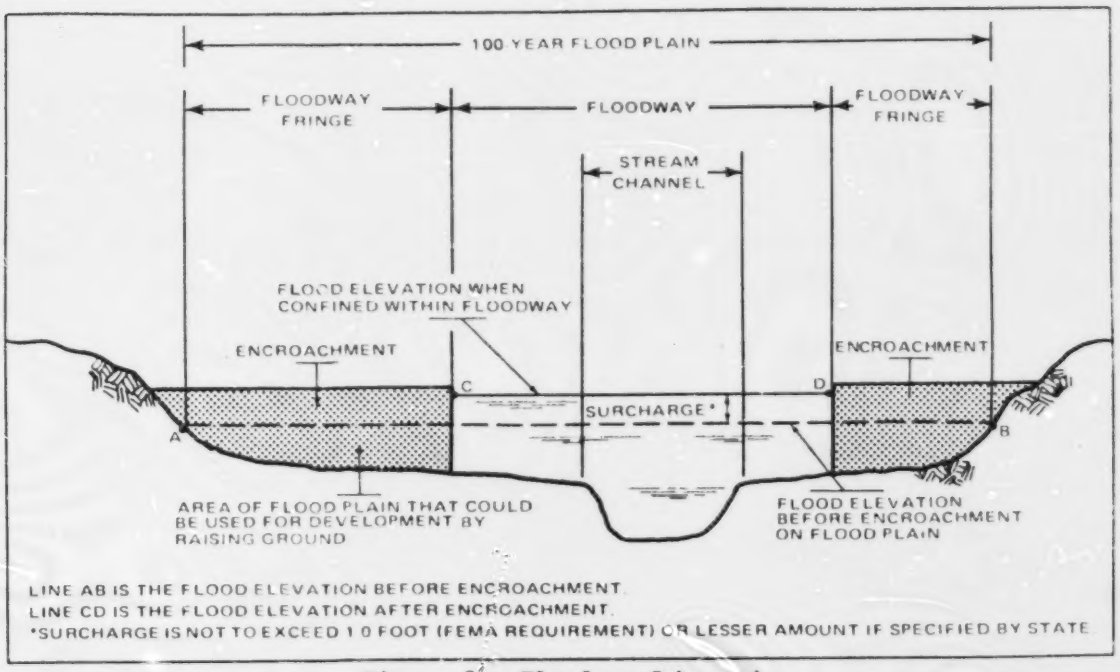
100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the Town of Lima.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the Town of Lima are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.

Zone A1: Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.

Zone B: Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other local water-control

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Junction Creek Reach 1	**0001**	**-0.5**	**-0.1**	**0.1**	**005**	**A1**	**Varies - See Map**

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF LIMA, MT
(BEAVERHEAD CO.)

FLOOD INSURANCE ZONE DATA

JUNCTION CREEK

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structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flood hazard; not subdivided.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Town of Lima is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the NFIP.

6.0 OTHER STUDIES

A Flood Insurance Study has been prepared for the City of Dillon, the Town of Lima, and the unincorporated areas of Beaverhead County, Montana (Reference 1). Information and analyses for Junction and Alder Creeks in that report were used for this Flood Insurance Study. Data presented for Junction Creek Overflow were revised based on new information supplied by the State of Montana. In addition, an area of shallow flooding along the left bank of Junction Creek was added based on the State's recommendations.

Because of the more detailed analysis, this Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map (Reference 7).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Building 710, Denver Federal Center, Lakewood, Colorado 80225.

8.0 BIBLIOGRAPHY AND REFERENCES

1. Federal Emergency Management Agency, Flood Insurance Study, City of Dillon, January 5, 1982 - Town of Lima, January 5, 1982 - Unincorporated Areas of Beaverhead County, Montana

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2. U.S. Department of Commerce, Bureau of the Census, Number of Inhabitants, Montana, October 1981

3. U.S. Department of the Army, Corps of Engineers, Omaha District, Flood Plain Information, Beaverhead River, June 1975

4. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, Users Manual, Davis, California, 1976

5. U.S. Department of the Interior, Geological Survey, Water-Supply Paper 1849, Roughness Characteristics of Natural Channels, H.H. Barnes, 1967

6. Montana Department of Highways, Aerial Photographs, Scale 1:9,600, Town of Lima, July 1975

7. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Town of Lima, Beaverhead County, Montana, July 1975

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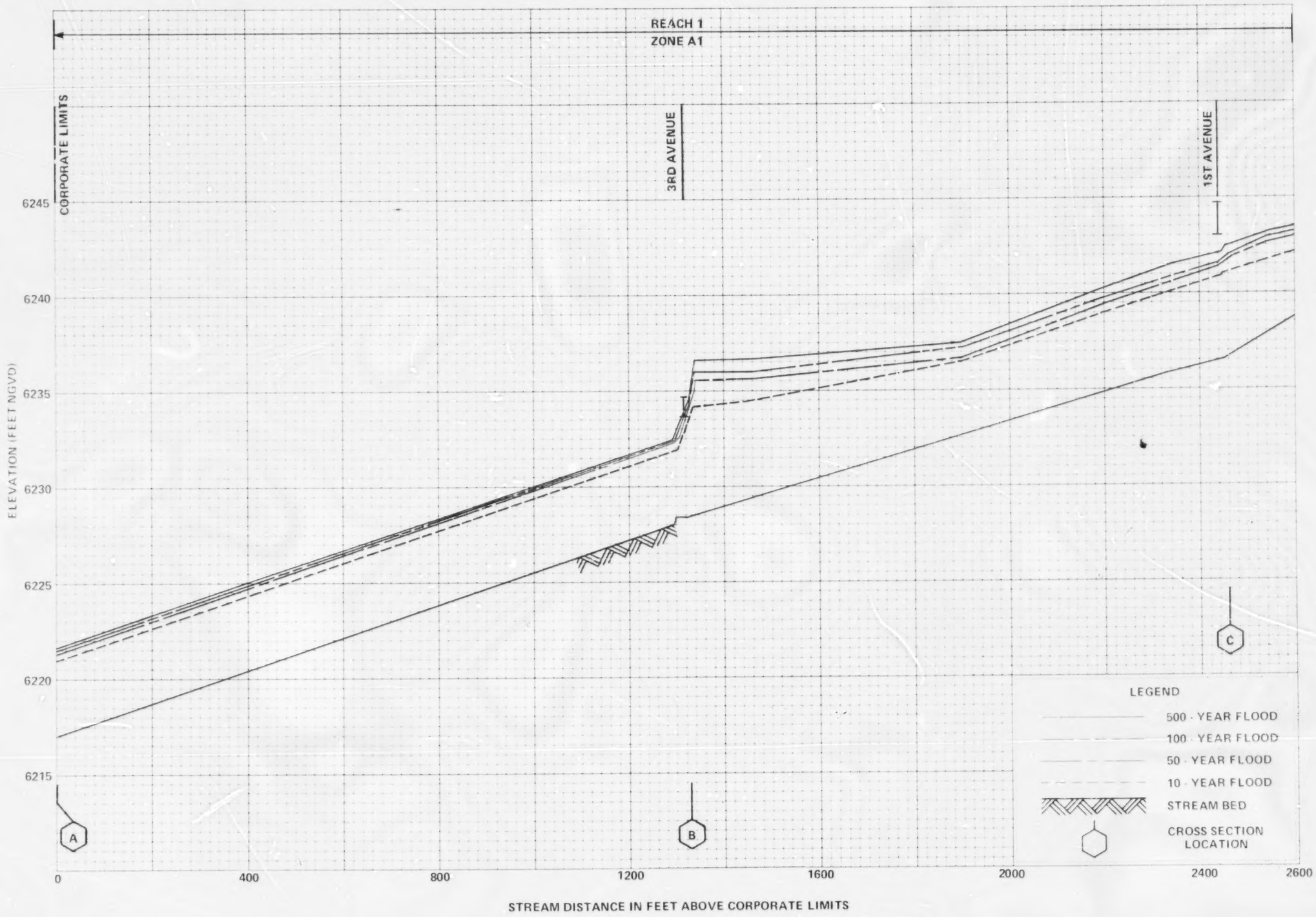

FLOOD PROFILES

JUNCTION CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF LIMA, MT
(BEAVERHEAD CO.)

01P

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REACH 1
ZONE A1

BAILEY STREET

SLADER STREET

ALDER CREEK

ELEVATION (FEET NGVD)

6270
6265
6260
6255
6250
6245
6240
6235

2600
3000
3400
3800
4200
4600
5000
5200

STREAM DISTANCE IN FEET ABOVE CORPORATE LIMITS

D
E
F
G

LEGEND

500 - YEAR FLOOD
100 - YEAR FLOOD
50 - YEAR FLOOD
10 - YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION

FLOOD PROFILES

JUNCTION CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF LIMA, MT
(BEAVERHEAD CO.)

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STREAM DISTANCE IN FEET ABOVE CORPORATE LIMITS

FLOOD PROFILES

JUNCTION CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF LIMA, MT
(BEAVERHEAD CO.)

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